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ABSTRACT

Educational changes implemented at Hunterdon Central Regional High School (New Jersey), based on a technical model that stresses mastery learning and is facilitated by a customized instructional technology, are described in this paper. A two-pronged strategy involves the formation of site-based management teams and a technology review committee. Plans also include the development of a campus-home computer network. The first section outlines plans for completion of two prototype classrooms, one for science and one for general technology. Curricular and instructional trends in mathematics, science, and educational technology are highlighted. The second section offers guidelines for the general design of various environments within the educational plant, with a focus on factors that impact facilities planning and on the characteristics of educational environments. The third section offers a description of Project Scope--which seeks to create two prototype classrooms--provides inventories, guidelines, and architectural designs for technology and biochemical laboratories. Four charts and 11 figures are included. (LMI)

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AMERICAN ASSOCIATION OF SCHOOL ADMINISTRATORS

124TH ANNUAL CONVENTION

SAN DIEGO, CALIFORNIA

ED345323

THE WAVE OF THE FUTURE

PROTOTYPE CLASSROOMS / LABORATORIES

for the
HUNTERDON CENTRAL REGIONAL HIGH SCHOOL DISTRICT
ROUTE 31
FLEMINGTON, NEW JERSEY

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I. EDUCATIONAL PROGRAM

I. EDUCATIONAL PROGRAM

INTRODUCTION

As America moves toward the portal of the 21st Century, indications are that this era will be unlike any other in the history of mankind. Robert Reich suggests in his latest treatise, "The Work of Nations," America will be a part of a new world order wherein success will in large part be determined by the number and quality of "symbolic analysts" (skilled knowledge workers) that a nation can produce for its labor force. By the very nature of this new world order, it must be concluded that America's schools will change since, historically, they have reflected our national interests (Toch, '91). Education will become the focal point of a synergistic environment of community, business and education working together to advance the goals and aspirations of our society in the global marketplace. Effective schools will no longer be isolated institutions of learning, accountable only to themselves (Deal, '85).

This transition should not be viewed in the same context as recent reform movements like the Sputnik crisis in mathematics and science in the 1960's, the need for basic skills in the 70's and the call to excellence in the 80's (Schlechty, '90). Rather this transition is taking on the appearance of a "call to arms." It is punctuated by the unprecedented media blitz from the White House about the woes of public education, spearheaded by the President "stumping" for national standardized testing and school choice. For the first time, we are given the impression that our socioeconomic way of life is being threatened, not by ideological currents, but by the economic success of others, notably the Japanese and western Europeans - a development we did not perceive possible even a few years ago.

American business has sounded the clarion that it's a much different marketplace. Business is warning Washington and the states that we must shift gears from an assembly line and high-volume manufacturing mentality (Reich '91) because other nations are doing that cheaper. Instead, education and technology must together concentrate on becoming a higher order thinking enterprise. We must bring problem solving to a new level. The message couldn't be clearer - whoever succeeds in this endeavor will be a leader in the new world order (Reich '91).

America's public schools have historically mirrored our national interest. The late 1800's saw our educational system change from the "little red schoolhouse" to the expansive structures of 20th century education replete with a curriculum that paralleled the mass production philosophy of "smokestack America." And now, just as then, public education is being asked to transform itself again to meet the needs of this new era. We must move from finite knowledge training to intellectual inquiry, from passive submission to the active search for knowledge, and to the development of higher order thinking and learning skills so our society can continue to enjoy its pre-eminent position.

This inexorable change to an informational society and to the realization that knowledge is power will demand a major infusion of technology based on the recognition that the body of knowledge is expanding faster than we can teach it in traditional ways (Schlechty, '90). We must recognize the necessity for a major technical model (Perlman, '87) stressing mastery learning and facilitate it by a technology designed to customize instruction for each student.

America's public schools must move away from the teacher as the focal point in the educational process - the "sage on the stage", if you will, to the teacher as facilitator - "guide on the side." The traditional classrooms of the structured, uniformly set day with 40 to 45 minute segments of instruction in various subjects will have to be replaced by flexible schedules allowing the individual student the time he or she requires to achieve mastery of given skills, thus recognizing a shift from a norm-based to a criterion referenced paradigm.

Here at Hunterdon Central Regional High School, we anticipate this major evolutionary change. We are beginning the process of shifting our resources and talent to that end. Students will no longer work in isolation, and teachers will no longer feed students information which is then played back via a standardized test. Instead, it is our belief that students will be actively involved in their own education through problem solving, decision-making, and utilization of available technology. We want our students to achieve success with this new model as soon as possible by blending the latest in technology into the curriculum.

To meet our goals we have developed a two-pronged strategy. First, the formation of site-based management teams consisting of teachers, administrators, students, parents and other community members as collaborative models of participatory management. A significant first step has already been taken with the report of an ad hoc committee of community members and staff presenting their suggestions for future facilities planning at Hunterdon Central Regional High School.* This will be followed up by another team's planning for the expansion of the site-base approach and its application to specific problems such as future scheduling needs.

Second, we have established a technology committee to review the present state of our telematic** (Perlman, '87) capabilities. Since our mission is "education for the 21st century," we must determine now the essential components for this new classroom environment. Presently, we are exploring ways to bring our 72-acre, 8 building campus into closer contact with our sending districts, other regional high schools and nearby colleges and universities. Our long range goals include the installation of a telecommunications facility, an interactive video system, local area network systems and prototype classrooms for the 21st century.

Ideally, five years from now, Hunterdon Central should be a state-of-the-art comprehensive high school. This means that the facility should include an additional building equipped with state-of-the-art labs. Every classroom would contain a monitor, at least one computer, and a telephone. All of this would allow instant communication and the capabilities of transmitting instruction and information to the entire campus at one time. In addition, in areas throughout the facility, interactive instruction would be occurring. Hunterdon Central would be linked fiber-optically to other institutions of learning throughout the state and, perhaps, beyond. This would allow our students to take courses at nearby universities such as Lehigh, Princeton, Rider, Rutgers, and Trenton State. In addition, students at those institutions could observe and participate in the educational process of secondary students in a variety of ways. Staff members at Hunterdon Central could participate on professional development training at nearby universities without leaving Hunterdon Central.

We foresee the day when Hunterdon Central could be a community institution utilized day, evening and all year round; because we know learning has become a life-long pursuit, we need to have both our students and our communityg each other's needs. With the facilities in place for interactive instruction, computer training and usage, and problem-solving activities, local businesses could certainly take advantage of the facilities for their own training needs.

*Report available on request to Superintendent

**A French term referring to the merger of telecommunications and automatic computation.

The fall of 1992 will also see our first operational instructional network connecting our freshman house computer laboratory with our media center. This would be the first step in a process to network our entire campus so that information could be accessed from any point on campus, as well as at home so that students can always be "plugged in" to school, day or night. We also expect our Local Area Network to improve student time-on-task and minimize student traffic from building to building. We see the day when our sending districts will also benefit. We are already exploring the potential use of networking our media center and its data bases to our sending districts, thus economically enhancing their curriculum.

By September 1992, our plans call for the completion of two prototype "classrooms for the 21st century," one in science (chemistry and biology) and the other in general technology. A year later plans call for two more prototypes in physics and fine arts. In all prototype classrooms, laser disk players, CD ROM players, and computers will be integrated into the instructional process.

Staff involved in the technology lab will need training in such specific areas as computer numeric controlled programs, computer-aided drafting programs, graphics packages, and desktop publishing activities. Staff involved in the bio-chemistry lab must receive training in collecting data utilizing hypercard programs to analyze and present data and a variety of new scientific instruments which will be utilized in both biology and chemistry labs. We view this training as a turn-key operation which will enable the staff involved during 1992-93 in the prototype rooms to train other staff members beginning in January of 1993 and throughout the summer of 1993 to utilize the equipment available in the prototype labs and the communications building.

In the future, Hunterdon Central will be measured in a new paradigm for instruction in the secondary school. Classrooms with students actively involved in their own learning will be observed on a regular basis rather than on a hit or miss basis. Students utilizing educational technology to solve problems and made decisions will become an everyday occurrence. Staff members moving from the front of the classroom to the center of student activity will be observed on a regular basis. All students will be successful. Dropouts will be eliminated, and the age of learners will be unlimited. Secondary students will be interacting with college students via interactive television on a daily basis if necessary. College students in teacher-training institutions will be interacting with Hunterdon Central staff members and with secondary students on a daily basis if necessary. The finest professional development from surrounding colleges and universities will be available in the interactive TV studios at Hunterdon Central. The community will know what is going on at Hunterdon Central because they will be viewing it on their cable system as well as participating in activities in the labs and classrooms of Hunterdon Central on a regular basis.

In terms of student achievement, we would expect that our students will continue to achieve well on the standard measures which have continued to indicate academic success. Although we do not beleive that these are the best assessment measures, we do believe that we will continue to provide students with the basis training and skills which would allow them to "pass the necessary tests." However, we believe we will be providing students with much more. Those will be observable portfolios and projects. They may be in the form of a video tape or a hypercard program for a musical score. We believe that that added experience of applied learning through technology and cooperative group work will give our students the edge in college entrance as well as in the work place. A self-evaluation of the project would include:

a. the number of teachers utilizing educational technology and instruction

b. the number of teachers utilizing alternative instructional strategies such as cooperative learning in instruction.
c. the number of students achieving success in both traditional and new assessment procedures.
d. a lower dropout rate.
e. a higher attendance rate for students and staff.
f. a facility which is utilized to its maximum potential.
g. a schedule which accommodates the learner and the new learning pardigm.

We expect to make mistakes as we move into the 21st century and shift our delivery system of instruction. However, we believe that we must move forward or all will be lost. The evaluation of our failures will be as critical as the evaluation of our successes as we move into the 21st century.

In conclusion, though our future plans are ambitious, we believe the future is now! We do not claim to have all the answers; but, we do believe that we have the capacity and wherewithal to take the first steps in what should prove to be a very exiting time in our history.

A team of educators has been working to make the proposed educational future a reality. Superintendent of Schools Raymond Farley and his staff have been actively working with Dr. Raymond E. Babineau and his colleagues at University Associates na, Educational Planners and Consultants, to develop the concept and prepare educational specifications and Mr. Larry Dunlap and his colleagues at Fred Thomas Associates, Architects, to conceptualize and prepare schematic drawings. The educational specifications have already been approved by the New Jersey Department of Education. Staff at the Department are currently viewing the schematic drawings for concurrence with the educational specifications.

CURRICULAR AND INSTRUCTIONAL TRENDS IN MATHEMATICS, SCIENCE, AND TECHNOLOGY

An analysis of trends in the subject matter areas reveals the extent to which the broad trends have influenced the specific curricular areas. With the turn of the decade and the approaching new century, a variety of professional organizations and study commissions related to the various disciplines have commissioned or issued reports on the future. Significant examination of the content, skills and values to be taught have resulted. What knowledge is of most worth? What skills must students possess to cope with the changing future?

Mathematics

After the era of the "New Math" and the concern that students understand mathematical concepts, a concern emerged about students' ability to simply calculate. The current trend is to be certain that both of these important areas of mathematical study receive attention, but the focus is on organizing mathematics around problem solving and the applicability of mathematics to life. Special emphasis is being given to the use of calculators and computers from the earliest grades. It is argued that current mathematics curricula are obsolete, excessively repetitious, and preoccupied with rote memorization of calculation skills, with instructional time insufficient and ill-spent. In 1989, the National Council of Teachers of Mathematics (NCTM) recommended curriculum and evaluation standards for mathematics for each school level. NCTM envisions five overall goals for all students: learning to value mathematics, becoming confident in one's own ability, becoming a mathematical problem solver, learning to communicate mathematically, and learning to reason mathematically. The document establishes a framework for a core curriculum that reflects the needs of all students, in explicit recognition that they will spend their adult lives in a society increasingly dominated by technology and quantitative methods. NCTM calls for the teaching of mathematics in a non-threatening environment in which students are encouraged to ask questions and take risks, using manipulatives, measuring devices, models, calculators, and computers with ample opportunities to talk with each other about mathematics. Changes in teacher education and evaluation practices are recommended, with new tests needed to shift the focus from computation to problem solving and reasoning. It is anticipated that the new eleventh grade HSPT will reflect the NCTM standards.

Science

"The terms and circumstances of human existence can be expected to change radically during the next human life span. Science, mathematics, and technology will be at the center of that change--causing it, shaping it, responding to it. Therefore, they will be essential to the education of today's children for tomorrow's world. What should the substance and character of such education be?" Science For All Americans, published by the American Association for the Advancement of Science (AAAS), poses this question and offers a recommended core curriculum for the future. AAAS has a long term, multiphase project known as Project 2061 with a fundamental premise that schools do not need to teach more content, but rather they need to focus on what is essential to scientific literacy and to teach it more effectively. Project 2061 argues that the world's future depends largely on the wisdom with which humans use science and technology, that scientific habits of mind can help people in every walk of life deal sensibly with problems that often involve evidence, quantitative considerations, logical arguments, and uncertainty. Project 2061 recommends that the traditional subject-matter categories be softened and that connections be emphasized. For example, transformations of energy occur in physical, biological, and technological systems, and evolutionary change appears in stars, organisms, and societies. Further, with the explosion of knowledge, the amount of detail that students are expected to retain should be less than traditional science courses now require. Ideas and thinking skills must be emphasized, rather than specialized vocabulary and memorized procedures. Other literature consistent with AAAS recommends that ethical and moral questions that result from the application of science be covered (e.g., genetic engineering, surrogate motherhood). A major curricular movement known as STS (Science, Technology, and Society) is attempting to integrate the sciences with other disciplines to examine the problems of society, particularly as they relate to the application of scientific principles and technologies. Some emphasis is being given to the environmental sciences as a cross-discipline study. Though long recommended, a trend is emerging for more "hands on" experiences with science from the earliest grades. These experiences may be simulated with the use of interactive technologies, but the notion is to have the student experience science and the application of scientific principles. Another emerging trend is that of partnerships with business and industry to reinforce the concept of technology as the application of science.

Technology Education

This area of education formerly known as industrial arts is rapidly changing. Technology Education is emerging as a comprehensive program concerned with technology, its evolution, utilization, and significance for commercial as well as home purposes. Students probe organizational patterns, personnel, systems, techniques, resources, products, and the socio-cultural impact of technology on the lives of individuals and groups. Offerings in this area are becoming broader in nature (manufacturing vs. metal shop) and take a more holistic approach to traditional areas. The trend is to focus on problem solving as opposed to project building. The integration of computer aided design and computer aided manufacturing (CAD/CAM) are being integrated into courses. The initial impact has been in the area of mechanical drawing, but it is rapidly spreading to all areas. Technology Education has also been affected by the STS movement in an attempt to integrate science and technology and to examine both practical and ethical implications for society.

TRENDS IN EDUCATIONAL TECHNOLOGY

The movement from making students and teachers "comfortable" with computers to using instructional technology as tools of learning is fundamentally changing the nature of classrooms, the responsibility for learning, and the role of the teacher. The importance of technology is that the new instructional tools can be manipulated to actively engage the learner in demonstrating understanding. Since emerging educational technologies are having a great impact upon the design or retrofit of facilities, a separate section on the impact is needed to highlight its importance.

Educational technology is changing rapidly. Four key concepts have emerged that characterize its direction.

- **Educational technology will be interactive**, controlled by the learner. It will engage the student and enhance decision making and problem solving. That fact alone will revolutionize the classroom and the place we call school.

- **Educational technology will make resources more accessible**, changing the place of schooling, the role of the teacher and the relationship between teacher and learner. With massive data bases, with visual images immediately available, the teacher will no longer be the holder and dispenser of information and the trainer of skills. Teachers will be more like coaches, mediating technology, diagnosing learning styles and proficiencies, and facilitating a variety of strategies.

- **Educational technology will be affordable.** It will not be reserved for the wealthy. It will be in reach of all learners, within the school setting, and outside the school setting.

- **Educational technology will be integrated**, bringing together many tools in exciting and creative fashion. The synthesis of computers with video technologies and with telecommunications is already present.

Schools are moving from passive computer literacy programs to the teacher and learner actively engaging technology. The movement from exotic curiosity to instructional tool includes some recent trends:

- Interactive laser discs permit the learner to manipulate data and images and have instant access to video, slide banks, data bases, graphics, images, recorded music, and speech.

- Advances in visual imaging, including high definition television, computer graphics, desk-top publishing, video laser discs and digital electronics will enhance all of the visual arts and encourage students to imagine, create and process visual images.

- Automated libraries are common to industry and higher education, yet public schools still have card catalogues.

- Massive data bases, easily accessed and manipulated through modems, CD-ROM discs, and hypercard stacks are revolutionizing research and student demonstrations of proficiencies.

- Satellite, fiber optics, television, telephones, modems, and fax machines are used for distance learning and communications around the world. Note the use students made of telecommunications in the 1989 pro democracy revolution in China to communicate ideas and, more importantly, images.

- Lap-top computers are becoming commonplace and will reach the classroom this century. Their portability will change the way we store and manipulate data.

- Music creation and instruction have undergone a radical transformation. Students can now create and immediately hear sophisticated compositions.

- Simulations through computer software and laser discs expand the ability of the learner to experiment and try solutions to problems and see consequences of decisions.

- Computer managed instruction can deliver and manage a curriculum at a learner's pace, with appropriate assessment and clues to learning difficulties.

- Hypercard technology, a sophisticated yet easy to use software, is changing the way we and our students work, think and present information. Linear reports may become antiques.

- Robotics and the instructions given to robots play an important role in developing logical and sequential thought.

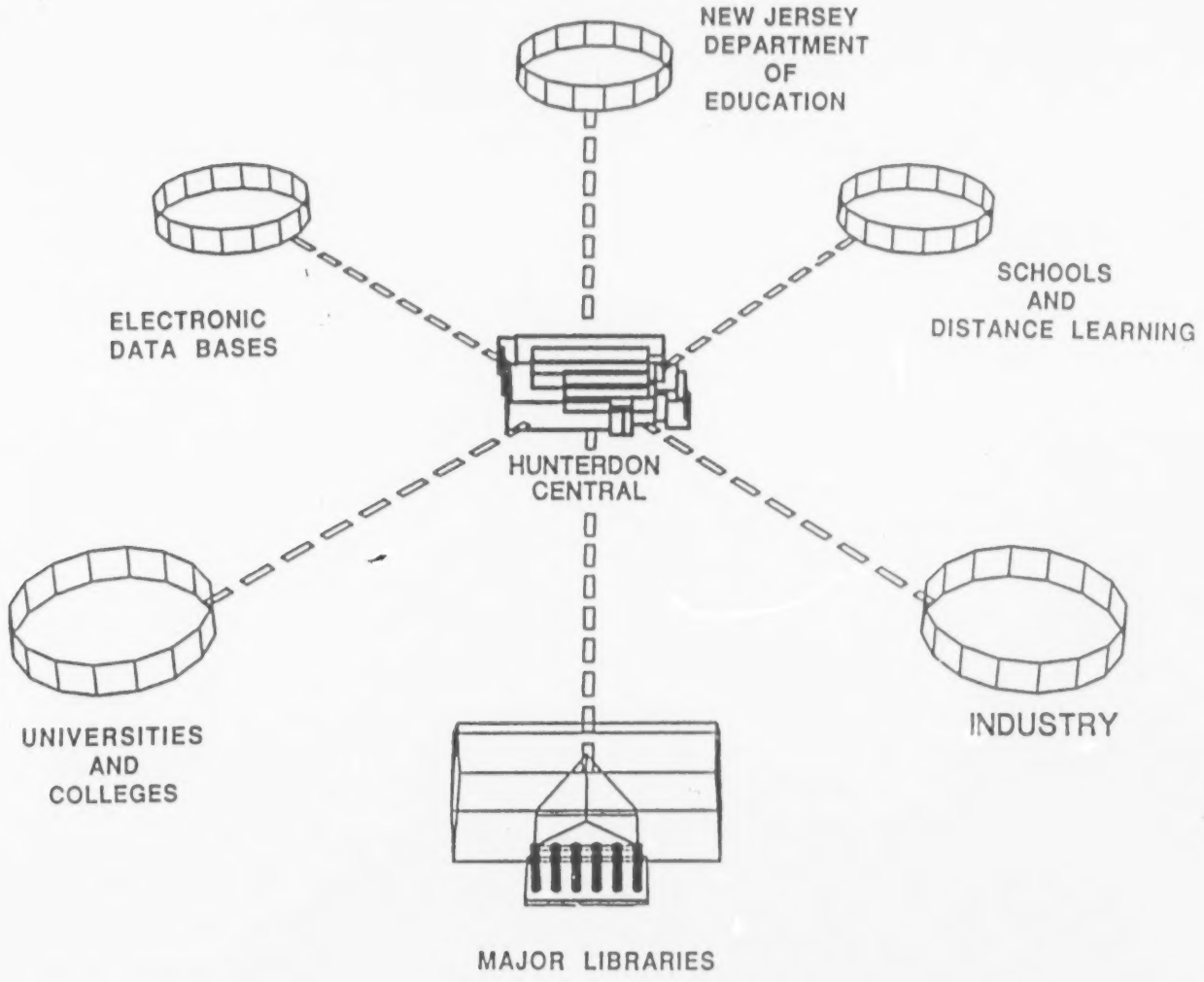
- Artificial Intelligence and the "age of the smart machine" will have implications we cannot even imagine. Using human cognitive research, researchers are now developing tutoring and coaching systems embedded with human expertise in neutral, endlessly patient machines.

An important concept in the use of any technology is that teachers must feel that they are in control of the technology, rather than the technology controlling them. This means that they not only feel "comfortable" in its use, but that they have the resources within their reach to use as the learning dictates.

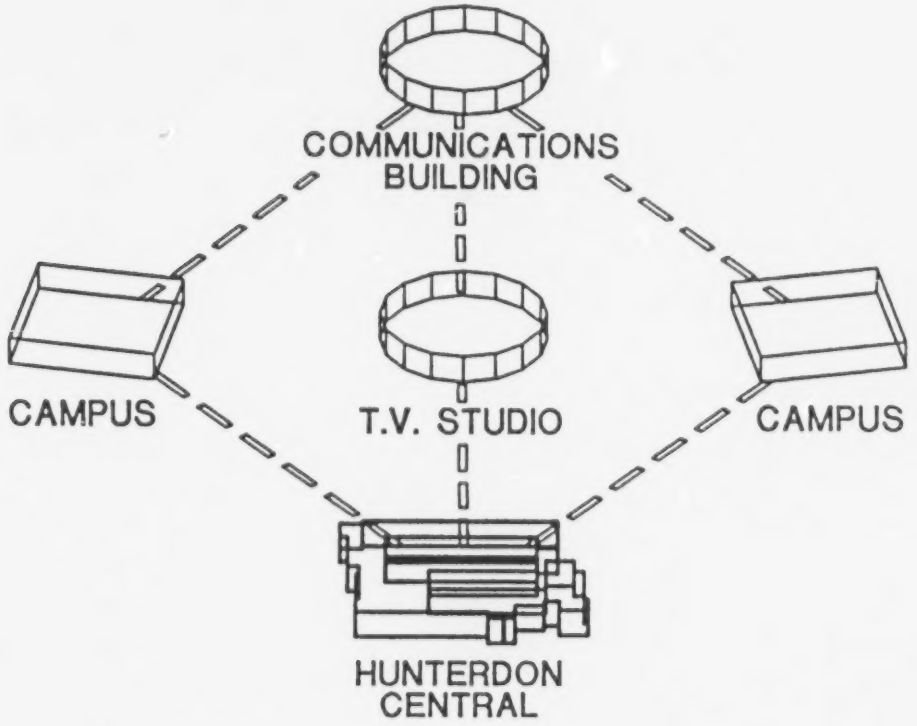
While schools cannot afford to ignore the opportunities that technology promises, we must also be reminded that technology will not alter the fundamental necessity for expertly prepared, articulate and creative teachers. Technology offers a powerful partnership between interactive tools of learning and teachers.

Educational leaders are needed who have a vision for the creative possibilities, who use technology regularly, who are willing to encourage colleagues to explore instructional implications, and who see the need to plan creatively. The use of educational technology must be needs driven, function oriented, and planned, with a dash of spirit and energy thrown in for good measure.

• POTENTIAL INTERACTIVE DATA SOURCES

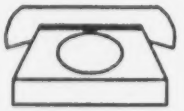


• INTRACAMPUS COMMUNICATION



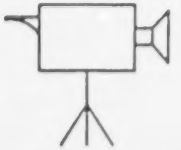
INTERCAMPUS COMMUNICATION

SATELLITE

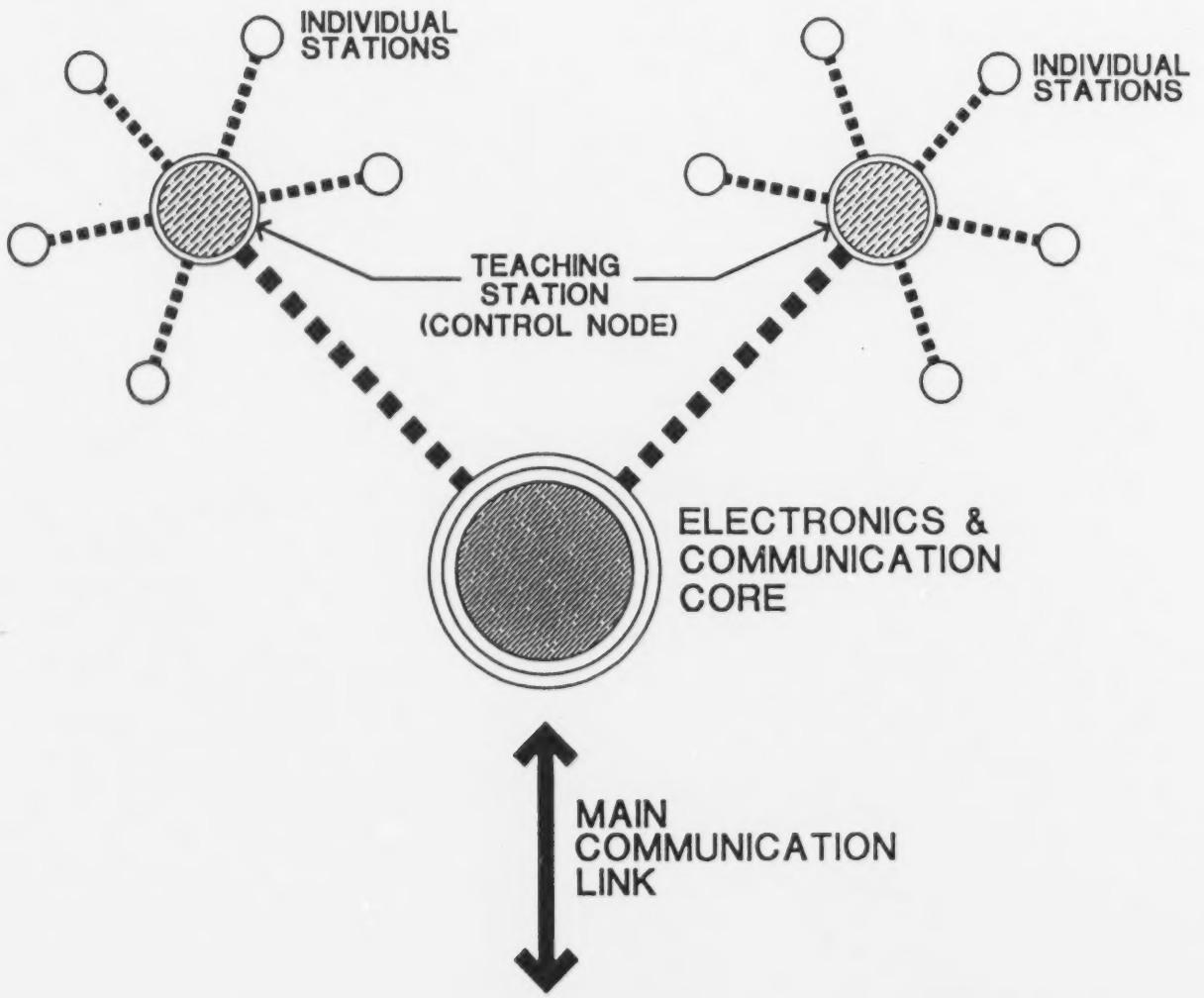

TELEPHONE

COMPUTER

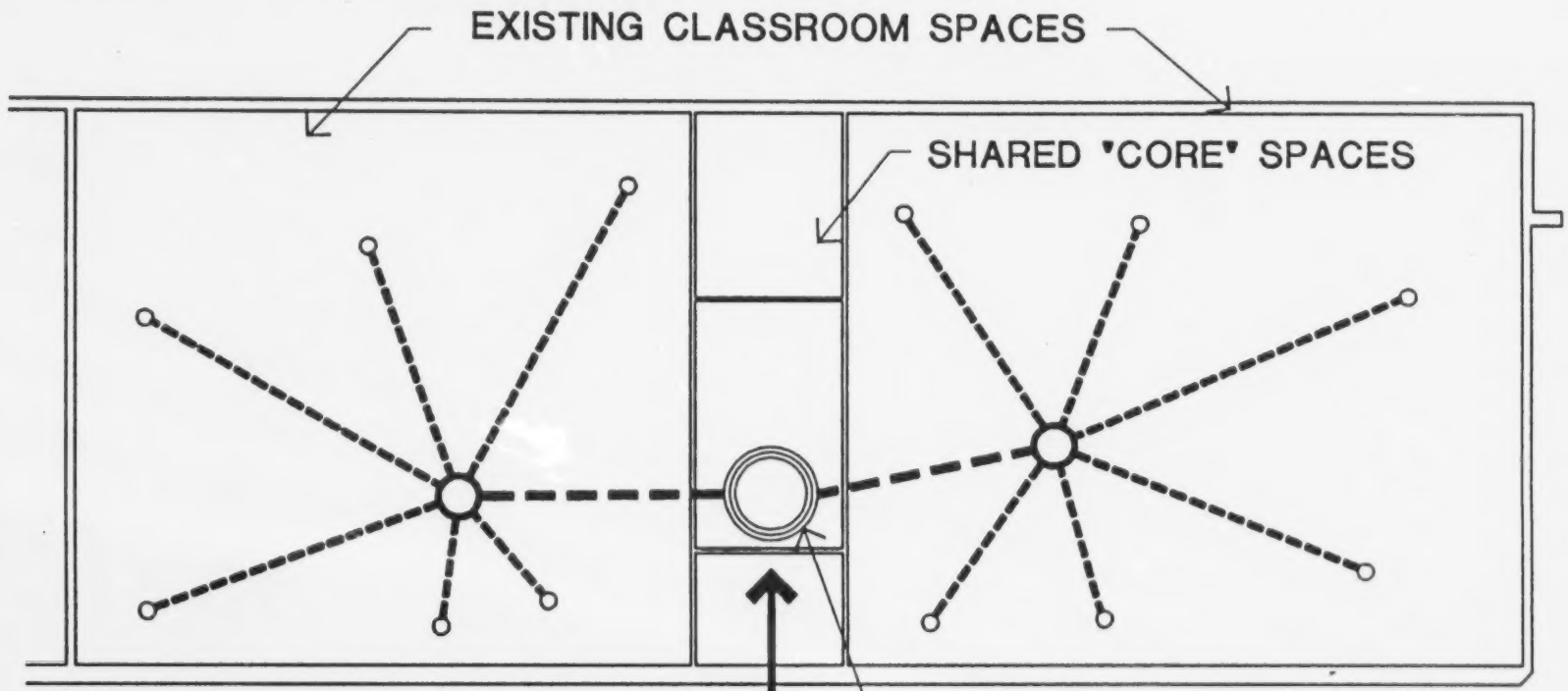
DATA


TELEVISION

- INTERACTIVE NETWORKING CONCEPT



• LABORATORY APPLICATION



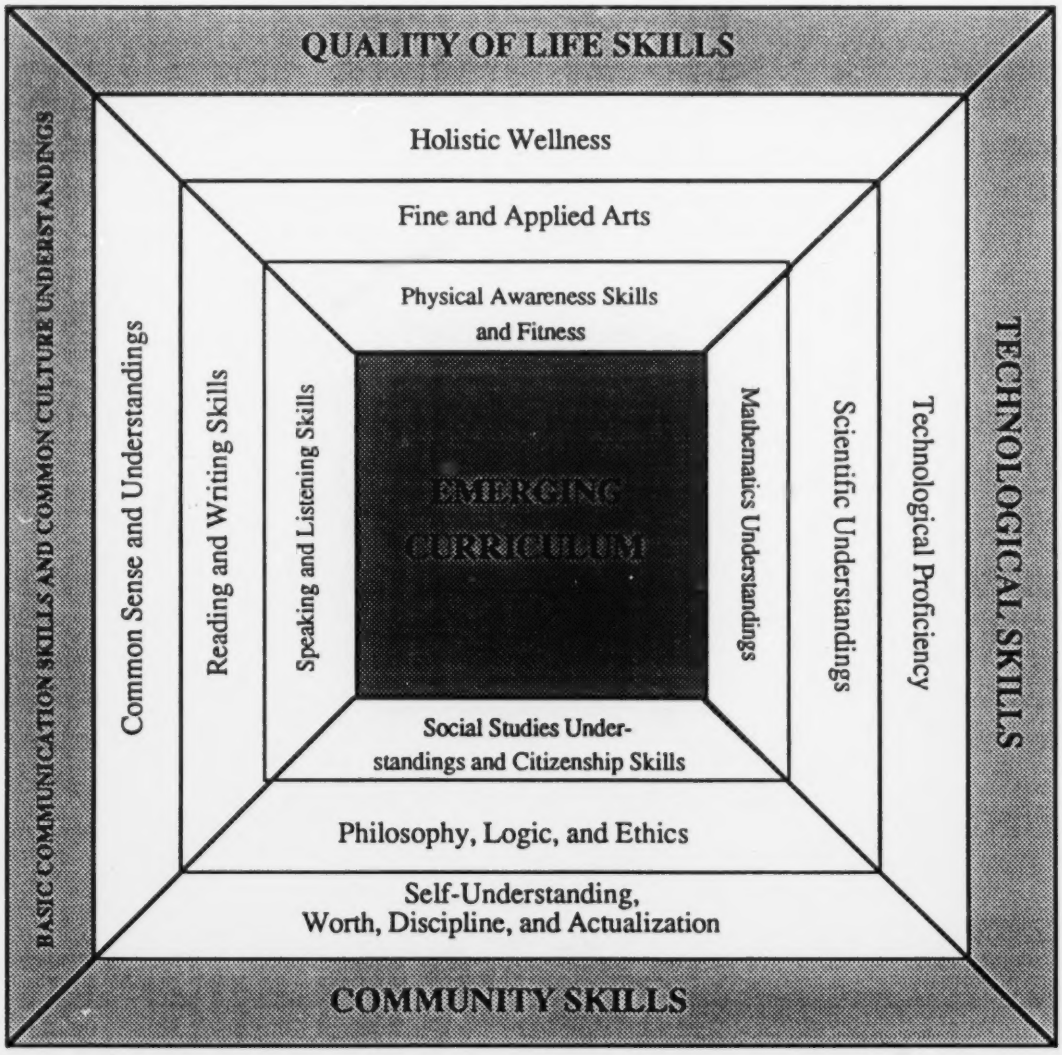
- CENTRALIZED NODES CONTROL INFORMATION & ELECTRONIC ACCESS
- NETWORKING DESIGNED TO PROVIDE FLEXIBILITY TO MULTIPLE USERS

TO COMMUNICATIONS CENTER

CURRICULUM OF THE FUTURE

From the foregoing materials on curricular trends and effective schools, one can begin to predict what the curriculum for a school of the future should encompass. The following figure presents a graphic model of such a curriculum that is likely to become the dominant pattern in American schools.

THE CURRICULUM OF THE FUTURE



Such a curriculum should provide the balance sought in educational programs, both curricular and co-curricular. If well implemented, this curriculum will have the potential of producing students who are well-rounded in the academic, physical, and affective domains. It is also from such a base that one can begin to conceptualize the sort of educational facilities that will be required to meet the future needs of schools.

IMPLICATIONS FOR THE FUTURE

1. **Develop prototype laboratory/classrooms of the future.**

   The district should develop prototype laboratory/classrooms where teachers can be trained in the use of current methodology and technology for the purposes of improving instruction and student attainment. These areas should become living laboratories for education in which teachers and students can together explore new ways to advance their knowledge.

2. **Place continuing emphasis on the use of emerging technologies as instructional tools**

   The district is already accomplishing many things with computers and other emerging technologies. The district needs to examine the use of technology as instructional tools in many areas, including:

   - Interactive video in the sciences, social studies, foreign language, and other areas;
   - Use of modems for communications (e.g., electronic mail, data retrieval, pen pals, computer conferencing);
   - Automated and computerized library collections, with electronic data bases, electronic card catalogues,

     electronic checkouts and inventory;
   - Simulation software;
   - Desktop publishing for student publications, and student projects;
   - Word processing for all students to improve writing skills, particularly in revising and editing;
   - Electronic creation and use in the creative arts;
   - Robotics (implications for the social sciences as well as the technological implications);
   - Speech synthesis;
   - Long distance learning through satellite reception and possible transmission.

3. **Information Processing**

   The district should place increased emphasis on the ability of the learner and in turn the worker to be able to locate and utilize information. This will be key in future educational programs. As the number of data bases increases, the skill to access and use them will become increasingly important. This skill, coupled with the ability to think critically about the information will become a primary thrust of education. The school district needs to place increased emphasis on the tools to access information through an expanded library/media center, data retrieval skills and use of computers within the curriculum.

4. **Ethical and Values Components in the Curricular Program**

The district should continue to integrate ethical and value components into its curricular program. Continuous examination of the curriculum is required to determine how well ethical questions are raised to challenge students. This is not to be confused with the direct teaching of core values that is currently being studied by the State of New Jersey as an instructional requirement. Given the nature of technology and the advancements of science, there are ethical questions which students must face.

5. **Interdisciplinary Teaching**

Implement the concept interdisciplinary teams of teachers who will create learning experiences for students that are drawn upon the richness of several disciplines and integrate that knowledge.

6. **Use of Educational Research**

Place even greater emphasis on locating and utilizing the findings of educational research in developing new programs and developing existing programs.

II. EDUCATIONAL FACILITIES

ENVIRONMENTS OF THE EDUCATIONAL PLANT

THE ENVIRONMENTS OF THE EDUCATIONAL PLANT

This chapter is provided for the guidance to the architect in considering the general design of the various environments of the educational plant.

FACTORS INFLUENCING FACILITY PLANNING

The trends affecting schools, outlined in the chapter on educational programs, send several key signals to planners of educational facilities about the characteristics required for an educational environment that will be viable both now and in the future. First, one must examine the factors that influence the planning of any educational facility. There are many, ranging from the needs of the students to community expectations, to demographics of the population, to state and local building codes. Each factor is not static, but changes with time. Community values and aspirations are perhaps more pluralistic today than ever before and tend to change more rapidly than in the past. The curriculum is in a constant state of flux as values change, new knowledge is revealed, new skills required, and new technologies developed and applied.

It is through an examination of the myriad variables that the planning process is able to account for the needs of the educational program and its clients.

CHARACTERISTICS OF THE EDUCATIONAL ENVIRONMENT

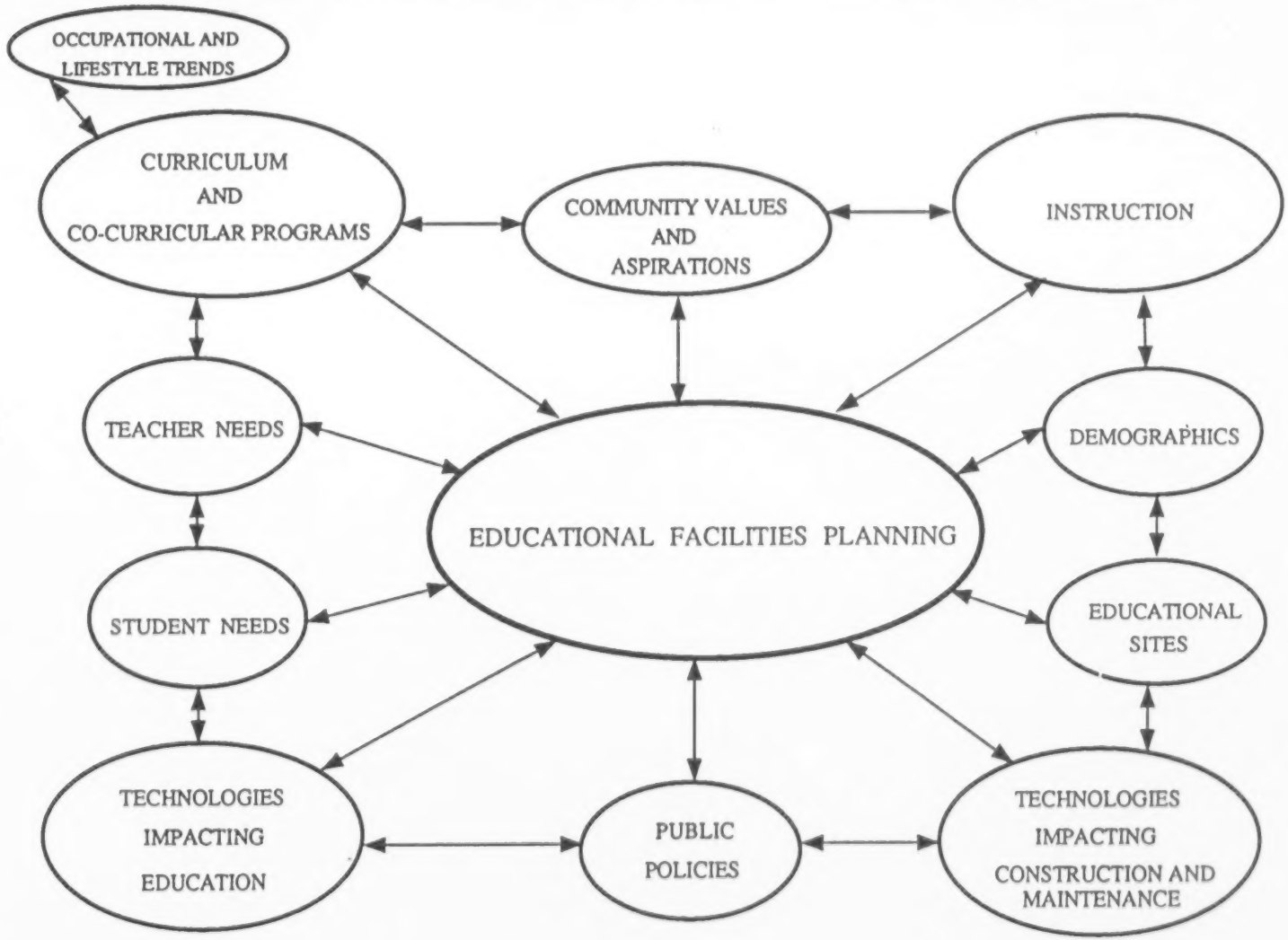
All of us have experienced the geometric expansion of knowledge in our lifetime. New skills are required of our students to meet the challenges of the workplace. Students are no longer the traditional five to eighteen year olds, but come from age groups younger and older. Technology is changing at a much more rapid rate than previously experienced. While many futurists attempt to predict future trends and have some success in that regard through the use of such techniques as environmental scanning and content analysis, the predictions often have failed to materialize in precisely the way they were portrayed.

While we can examine the known trends for the short term, we must look to more enduring characteristics of educational environments for the long term. If we examine the direction in which the trends are pointing, the curriculum that is emerging, and the resulting instruction and its use of technology, several universal characteristics emerge to guide our planning efforts. Those characteristics point to the need for the educational environment to be:

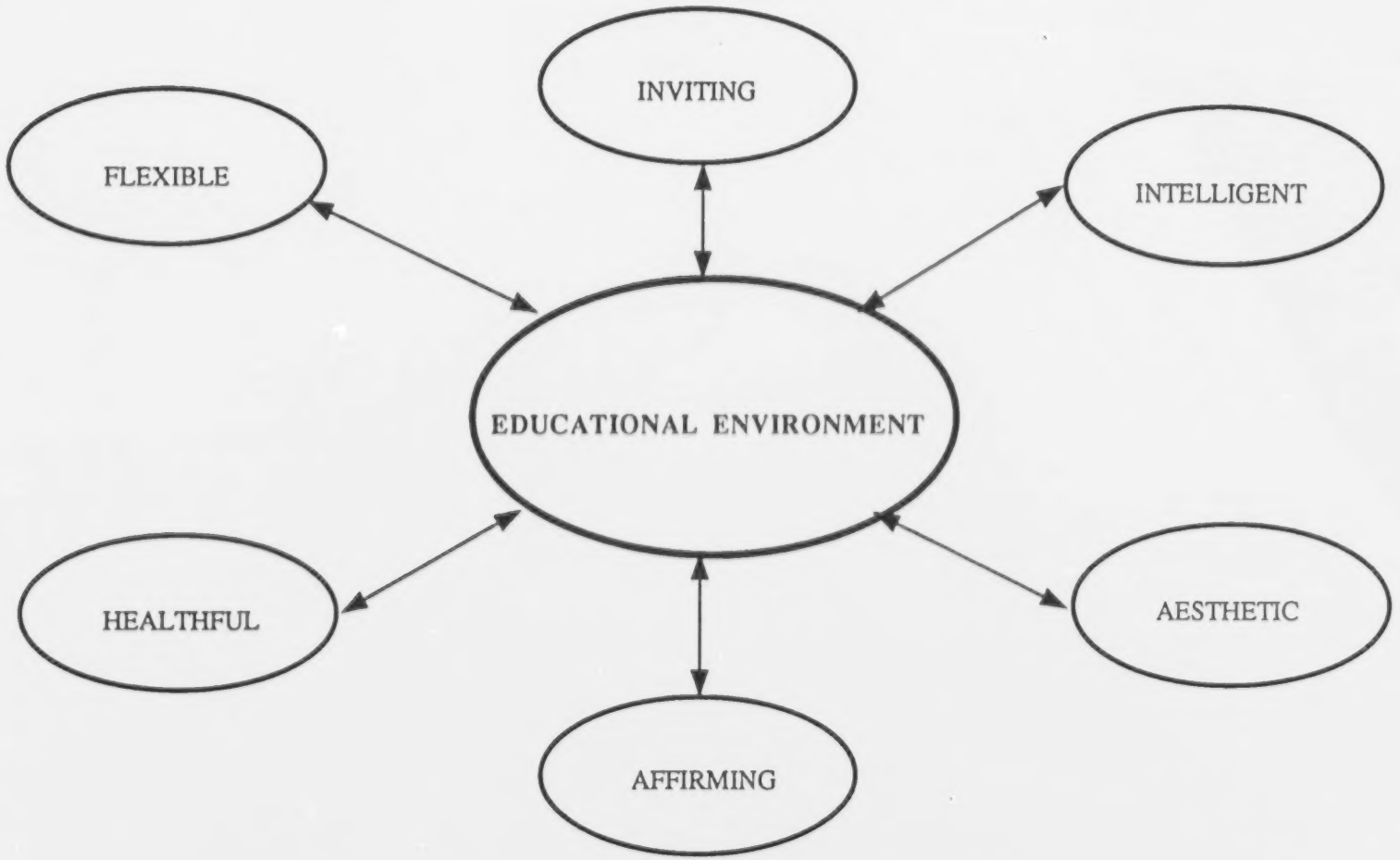
Inviting
Affirming
Aesthetic
Flexible
Healthful
Intelligent

The switch to the term *environment* in place of the word *facility* is deliberate. It is likely that educational programs of the future will not be limited to a single facility, but may range from the home to other community resources that will enhance student learning.

FACTORS IMPACTING EDUCATIONAL FACILITIES PLANNING



CHARACTERISTICS OF EDUCATIONAL ENVIRONMENTS SERVING THE NEEDS OF EDUCATIONAL PROGRAMS



The Environment as Inviting

If the users of the facility fail to find an openness and nurturing environment that encourages learning by inviting exploration and by engaging the learner in asking questions and seeking answers, then a basic motivational factor is lost in the educational process. A basic question to ask here is, "Will this school be as exciting a place as the community and society that surround it?"

The Environment as Affirming

Both students and teachers must find personal affirmation in what happens in educational environments. The primary question here is: To what extent will the facility contribute to personal affirmation by providing the space and resources to realize personal and organizational goals? How will the environment of the school bond learners together?

The Environment as Aesthetic

Aesthetics has been a concern of man from the earliest times. While aesthetics may be viewed differently by different individuals, a primary question to be raised is: Will the school be viewed as generally pleasing from an aesthetic point of view and will it allow individuals and groups to modify the environment to meet their definition of aesthetics? Much research exists on the positive and negative influences of various styles and colors upon learning and behavior.

The Environment as Flexible

Flexibility must be looked at from two points of view, short-term and long-term. Teachers and students need the ability in the short term to rearrange the instructional setting to meet the task of the day. The second type of flexibility speaks to the broader rearrangement of the facility as overall program needs change. Technology will change, instructional strategies will change, organizational patterns will change (e.g., different grade configurations), new programs will be added while others are modified, and staffing patterns and roles will change. The question then becomes: To what extent will the design of the facility encourage both short-term and long-term flexibility. The old "egg crate" school of past years has placed serious limitations on many current programs.

The Environment as Healthful

In the age of AIDS, asbestos, and carcinogens, parents, teachers, and students need to be assured the school is a healthy place: healthy in the sense that there are not harmful substances in the air and water supply, and healthy in the sense that the environment promotes healthful practices such as exercise, good eating habits, stress reduction, and personal hygiene. The question to be explored is: To what extent will the educational facility assure its occupants a healthful setting in which to teach and learn?

The Environment as Intelligent

To a great extent the educational facility should be a background for teaching and learning and should not intrude on those processes. Factors such as climate control, lighting, acoustical treatments and access to resources become the supportive background and often can be automated, contributing to the sense that the building serves the educative process rather than controls it. The primary question to ask here is: What can reasonably be automated and controlled, and what must be placed in the control of individuals using the learning environment?

PROTOTYPE CLASSROOMS/LABORATORIES

PROJECT SCOPE, PROGRAM, AND SPECIFICATIONS

PROJECT SCOPE

The project entails evaluating two existing shop rooms (metal and wood-working, rooms 102 and 104) in the High School building and developing conceptual design proposals for renovating these rooms. The renovated spaces are to serve as technologically advanced laboratory prototypes, serving biochemistry and technology education functions. These spaces are to incorporate advanced educational instructional equipment and their utility and service requirements. The design is to accommodate current "state of the art" technology as well as future technology advancements. The project Education Specifications further detail the school district's intentions and requirements.

Construction estimates will be developed for each solution, in conjunction with the Educational Consultant's specifications.

PROJECT PROGRAM

Through interviews with the faculty project planning committee, cooperation with the Educational Consultants to the School District who prepared the Education Specifications, and evaluation of the existing classroom spaces, the following design program has been developed. Overall, the project is to incorporate intelligent design concepts that serve and enhance the educational process.

1. As these work environments are to serve as prototypes, the flexibility of the space should be so designed as to encourage experimentation with different teaching concepts. Fixed walls should be used only where necessary, utilizing easily rearrangable wall systems, furniture, equipment and utilities.

2. Orientation of instructional spaces and/or furniture layouts may be designed to provide a unique organizational contrast to encourage interest and experimentation, contributing to the teaching environment. This may be achieved through the use of non-traditional plan arrangements and deliberate restructuring of the standard rectangular classroom space.

3. An area is to be provided for visitor/student observation of activities in the learning environments, to encourage participation and interest. This, in effect, becomes the third "instructional space", an area for the community, educators and other professionals to observe and learn.

PHYSICAL SPACE CONCEPTS

1. Two distinct learning environments are to be provided: Biochemistry laboratory and Technology laboratory. Spaces are to have access between each other to allow student and teacher interaction.

2. A shared Teacher Preparation area with access to each laboratory is to be incorporated into the space. The shared area will encourage interaction between educators and curricula.

3. An elevated Observation area is to be incorporated into the design, with direct access to a primary circulation corridor. The area is to be centrally located between the two laboratories and acoustically controlled (to promote discussions), allowing observation of both spaces.

4. Learning environments are to maintain a flexible design, allowing alterations to the room layouts with a minimum of change or disruption to fixed building systems (structural, architectural, electrical, mechanical and plumbing).

5. Aesthetic considerations are to include color, visual acuity and texture in the selection of materials, finishes and furniture. Ergonomic standards will be incorporated in furniture specifications and design.

6. Building environmental systems are to be designed and specified to address typical classroom problems, e.g.: lighting controls (natural and artificial), HVAC requirements (air conditioning and thermal controls), acoustic controls, fire safety controls, and security requirements.

7. Learning environments are to be capable of accommodating advanced technological systems, including computers, electronics, communications, and related utilities, services and equipment controls. Walls, floors, and ceilings are to be designed to enable easy access to these systems.

8. Learning environments and instructor spaces are to be designed to be fully accessible.

DESIGN DETAILS

ARCHITECTURAL

1. The architectural design of the spaces is to allow for maximum flexibility, adaptable to reconfiguration.

2. The Observation area will be elevated above the finished floor level, to enable unobstructed viewing of the learning environments. The space will be glass enclosed and acoustically controlled through the use of acoustic sound proofing. Horizontal blinds will provide a means of viewing privacy. Observation room lighting and speakers from the laboratories maybe controlled from the space.

3. Direct access to the Observation area and Preparation area is to be provided from the corridor, as practical to the overall design solution. A door into the Observation space may be optional.

4. A new "exterior" corridor is offered as one solution, serving circulation needs and efficient utility access requirements, as well as allowing for additional observation areas.

5. Exterior windows and skylights are to be located and designed to maintain control over natural light and glare, which adversely effect computer VDT screen use. Window size, location, and room darkening controls are to be specified for optimum room usage and function.

6. Free-standing and fixed furniture systems capable of meeting complete wire management, storage, and functional provisions are to be developed or specified from manufacturers. Specific contract furniture systems such as Steelcase, Knoll and Howe are to be evaluated.

7. Storage space is to be provided through cabinets, furniture systems, and compartments designed into fixed (permanent) spaces. Overhead storage space is to be incorporated over areas such as the Teacher Prep room.

8. Display cases are to be incorporated into walls along the primary corridor, allowing displays of various laboratory projects and features.

HEATING. VENTILATING & AIR CONDITIONING

1. Provide automated HVAC, lighting, and security controls, utilizing state-of-the-art systems to improve the teaching/learning environment and reduce operating costs. Automated systems are to balance and control heating and cooling levels.

PLUMBING

1. Plumbing systems (water/gas) are to be located, whenever possible, close to fixed perimeter walls to minimize utility runs. A raised floor or similar floor system will allow under-floor flexibility of utilities.

ELECTRICAL

1. Electrical/telecommunications access is to be addressed in three ways: below floor (trenching or raised-floor), perimeter (inside permanent walls), and overhead. Each system is to be designed to allow maximum flexibility to modify the learning environments.

2. The design will incorporate automatic systems regulating lighting intensity levels based on required light levels and available light sources.

3. An integrated security system and fire protection system is to be incorporated.

4. A central electronics/telecommunications control space is to be provided for networking and branching electronics and telecommunication equipment into the individual learning environments. The teaching stations are to serve as the control node for each environment.

SYSTEM SPECIFICATIONS
ARCHITECTURAL

WALLS

1. CMU (concrete) interior walls at existing perimeter walls. New interior walls to be steel stud framing with gypsum wallboard. Sound-absorbing panels to be located around rooms to control reflected noise. Wall paint to be "satin finish" to reduce glare.

GLAZING

1. New windows to be insulating glass with horizontal steel blinds for light level control. Windows along exterior walls (concepts "A~ and HC" typical) to be located above work level (approx. 8' high) to provide work and storage spaces along wall and reduce direct natural light. Full length glazing along wall may be strategically placed to allow visual access to exterior.

CEILINGS

1. Open ceilings with suspended metal acoustical panel sections to aid in controlling reflected sound levels. Open ceiling areas allow access to utility systems above.

FLOORING

1. Raised flooring or similar system, with surface finishes varying on specific areas, e.g.: resilient composite surfaces in woodworking areas, carpeted surfaces in lecture areas. Flooring material at entry areas to withstand "wet" traffic.

DOORS

1. Incorporate maximum glazing as permissible by Code.

MARKER & TACK BOARDS

1. Non-glare white dry-marker boards and fabric tack surfaces installed at instructional spaces. Automated copy-marker boards may be specified.

PROJECTION SCREENS EQUIPMENT

1. Integrated with overhead projection systems, to be tied in with electronic video equipment.

FURNISHINGS

1. Casework to be installed throughout layout to maximize storage. Furniture systems to be functional to specific tasks, but provide capability for electronic wire-management for the "electronic classroom". Furniture to be integrated in color and design.

MECHANICAL

1. Roof-top air conditioning systems to provide cooling to all spaces. Heating provided by ceiling or wall unit ventilators. Controls regulated by individual space.

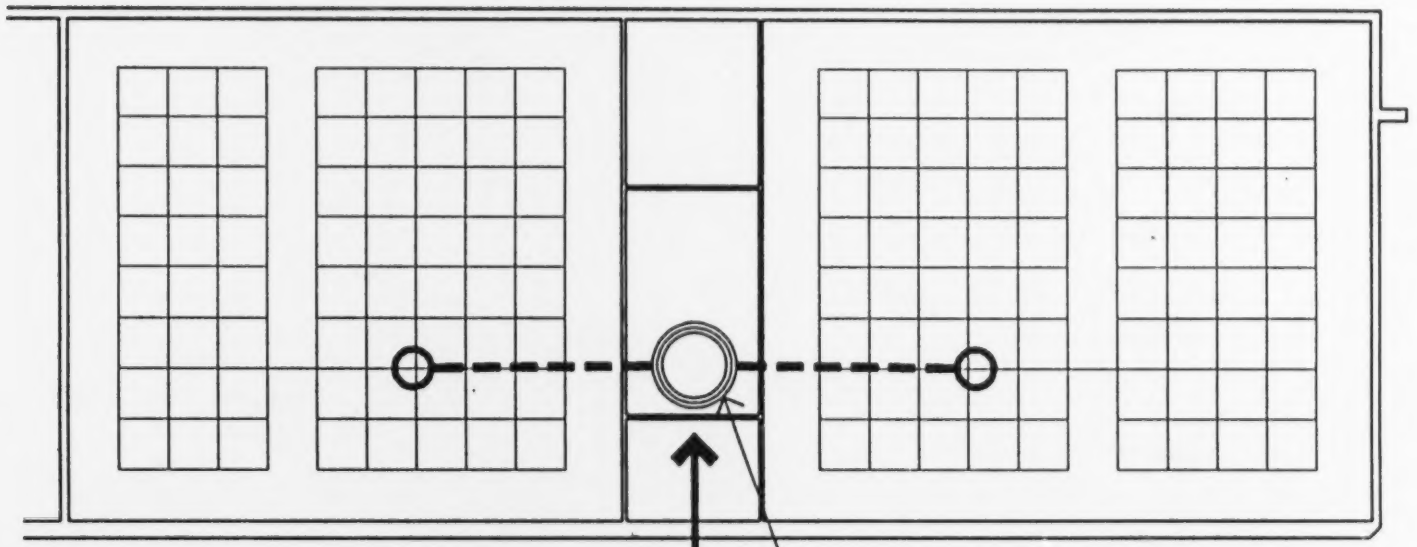
ELECTRICAL

1. Provide indirect fluorescent lighting systems in general areas. Computer work stations and specific work areas to have individual direct lighting. All lighting systems to be centrally controlled. General area lighting to be sensor-controlled to variations in actual lighting levels.

TELECOMMUNICATIONS EQUIPMENT LINES
(COMPUTER, TELEPHONE, TELEVISION, ETC.)

1. Managed from central service space. Controls for individual rooms to be managed from control "teaching" nodes, and other specific areas in room as required by tasks.

- ELECTRICAL & TELECOMMUNICATIONS



- PERIMETER WIRE MGMNT.
- FLOOR WIRE MGMNT.
- CEILING WIRE MGMNT.
- EASILY RECONFIGURED

FLEXIBILITY & ADAPTABILITY

TECHNOLOGY LABORATORY

TECHNOLOGY LABORATORY

STUDENT CAPACITY FOR INSTRUCTIONAL PURPOSES OF 24 MAXIMUM 1787 SQUARE FEET

PROGRAM NARRATIVE AND SPECIAL FEATURES

The technology lab will be used for instruction in two of our elective course offerings - Introduction to Technology and Invention and Innovation. The lab may also be used for our Materials Technology elective. These courses are designed to assist students to utilize a variety of technologies to solve problems. These problems vary in degree of difficulty as well as in content. Some of the mediums which are used to solve problems include the computer, wood, metal, foam, plastic, ceramics, paper, cardboard, robotics (Legos), and lasers.

In addition to utilizing the technology lab for the elective courses, the lab will also be used for applied activities related to all areas of the curriculum. We can see immediate applications in the lab for science and mathematics. The lab will also have the capacity to accommodate applications relating to other academic content areas. Because of the diverse nature of the activities which will be addressed in the technology lab, a variety of areas have been designated to accommodate those activities.

TEACHER STATION

The equipment which will be needed at the teacher station will include a computer equipped with a barcode reader. This area will also be the area where a capacity for interactive TV will be housed. The activities occurring in the Communications Building of the high school should be capable of being received interactively at this teacher station. The prototype teacher station will be utilized for training of teachers in all curricular areas and, therefore, must contain a wide variety of instructional support material. Minimally, this will include a laser disc player, a CD player, and a ceiling mounted video projector which can be computer controlled. There should also be the ability for the teacher to view, control and exchange files with the CAD stations from the teacher's computer.

CLASSROOM AREA

The key to this classroom area will be flexibility. Although some traditional teacher-directed lessons will be taught in this area, it must also be capable of accommodating other instructional strategies such as small cooperative learning groups. The sizes of the groups will range from between two to five students depending upon the types of activities which are being conducted. Furniture to accommodate state-of-the-art classroom needs will probably need to be custom designed.

ROBOTICS/LASERS

Students in the technology, science and mathematics classes will use this area to experiment with programming robotic arms and using lasers. Lists labeled "CAD/Robotics and Laser/Electronic Experimentation Area" indicate the types of equipment which Phil Hammel has been investigating to be included in this work area. The Scorbot-er III robotic arm is designed specifically for instructional purposes. It will be programmable using the computers which are located in the CAD area of the classroom.

CNC LATHE/MILLING MACHINE

The CAD area will house six computers. Current thinking is that the two IBM PS2 computers which are currently being used will be moved to the tech lab. In addition, we will purchase four additional computers, an ink-jet printer, and an additional plotter. Although the specific type of computer has not been selected at this point, we have been studying the advantages and disadvantages to those which we are using and those which are available. The Paxton-Patterson Company has a new program entitled PAX/CAD which will be evaluated for the possibility of utilizing this drafting software. It appears that this software incorporates the drafting programs which are currently being used in the technology classes (Easy CAD) as well as a word processing package which would allow students to draw and design and incorporate notes and textual references utilizing the same program.

GRAPHICS/DOCUMENTATION AREA

This area will overflow into the computer (CAD) area as well as into the air brush area. Students will be able to graphically represent designs, models and ideas using the computer as well as a variety of other graphic processes including air brushing and silk screening. The computer program which is being considered at this point is desktop publishing. In addition, a list of equipment which would be added to this area is included on the attached "Graphic Representation Area" list.

PROTOTYPING/FABRICATING AREA

The machine equipment area represented on the floor plan will be utilized for prototyping and fabricating student designs and models. Students will be working with wood, metal, plastics, and ceramics in this area. The majority of the equipment will be small table-top equipment. The area is designed for prototyping, not necessarily finished products.

The attached list of suggested equipment to be included in the "Prototyping/Fabricating Area" does not include two pieces of equipment which we currently have on hand. We are considering including our arc-mig & tig and oxy-acet welders in this area. Equipment and materials related to ceramics have also been excluded from this list because we need to further study the best means for dealing with this medium.

MODELING/STRUCTURES AREA

The area to the right of the machine equipment area on the floor plan would be an area which would allow students to work in building models and structures of their ideas and designs. This might require some space for testing CO-2 cartridge cars, bridges, or other models or structures.

ELECTRONIC EXPERIMENTATION AREA

This area will allow students to experiment with electronics in a step-by-step fashion. The current thinking is that we would utilize a prepared package program such as the Greene Manufacturing electrical benches (listed on the "Laser/Electronic Experimentation Area" list). These are programmed materials which allow students to experiment with electronic components in a sequential manner. As we continue to study the classroom areas, we may modify this selection.

While we recognize the impact of electronics in terms of technology, the larger plan is to add a physics/electronics room in the next phase of the science/technology prototypes.

TECHNOLOGY LABORATORY

STUDENT CAPACITY FOR INSTRUCTIONAL PURPOSES OF
24 MAXIMUM
1787 SQUARE FEET

LISTING OF
OCCUPANTS, EQUIPMENT AND FURNISHINGS

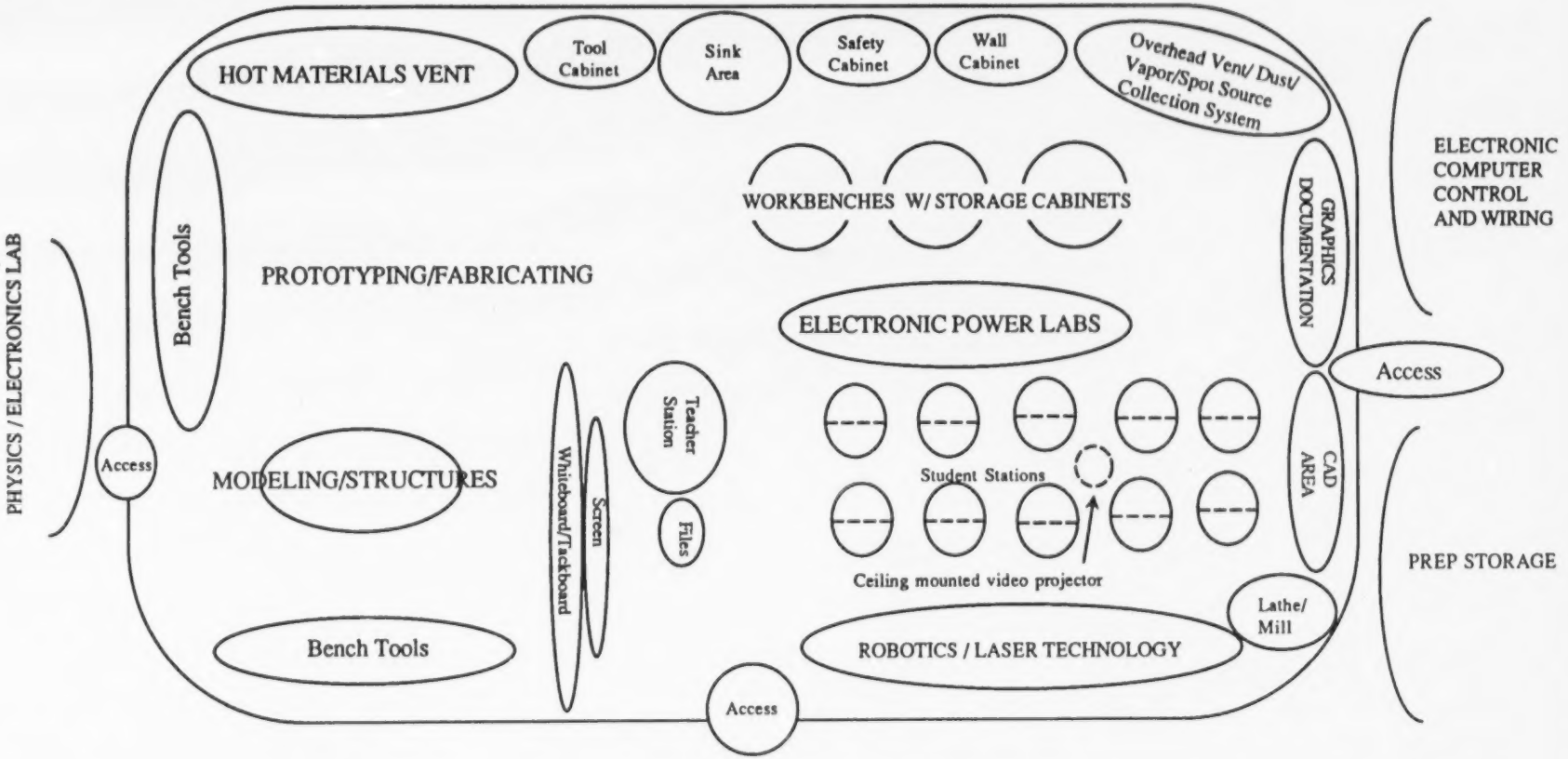
Number	Item	Net Square Feet	Total Square Feet
	OCCUPANTS		
24	Students	50	1200
1	Teacher	50	50
		Subtotal	***1250***
	CLASSROOM AREA		
12	Student Stations (2 students per station)	6	72
24	Student Chairs	1.5	36
1	Teacher Station w/ chair	20	20
	Ceiling Mounted Video Projector	No Floor	Space
		Subtotal	***128***
	ROBOTICS/CNC AREA		
1	Table w/ Scorbot Robot	15	10
1	Lathe Mill Bench	10	10
1	Mill and Bench	10	10
		Subtotal	***30***
	COMPUTER/CAD AREA		
6	Computer Stations w/ chairs	6	36
1	Printer Station	6	6
		Subtotal	***42***
	GRAPHICS AREA		
1	Graphics Bench w/ Storage	20	20
4	Chairs	2	8
1	Airbrush Compressor	No Floor	Space
		Subtotal	***28***
SUB TOTAL THIS PAGE			***1478***

TECHNOLOGY LAB
LISTING OF
OCCUPANTS, EQUIPMENT AND FURNISHINGS

Number	Item	Net Square Feet	Total Square Feet
	LASER AREA		
1	Laser Bench	10	10
	Laser Instruments	No Floor	Space
		Subtotal	***18***
MODELING	**/ PROTOTYPING / FABRICATING**	**AREA**	
2	Workbenches w/ Storage Below	25	50
1	Mobile Glue & Stain Base	10	10
1	Sheet Metal Table	17	17
1	Workbench w/ Locker Base	25	25
1	Tool Locker w/ Tools	10	10
1	Band Saw	4	4
1	Jointer	4	4
13	Locker Base Cabinets	6	78
4	Stools	2	8
	Shop Mate Tops	No Floor	Space
1	Table Top Drill Press	No Floor	Space
1	Table Top Band Saw	No Floor	Space
1	Table Top Miter Saw	No Floor	Space
1	Table Top Belt Sander	No Floor	Space
1	Table Top Foam Cutter	No Floor	Space
1	Table Top Injection Moulder	No Floor	Space
1	Table Top Bench Saw	No Floor	Space
2	Scroll Saws		
		Subtotal	***206***
	ELECTRONICS		
2	Lab Units	15	30
2	Chairs	2	4
		Subtotal	***34***
	OTHER EQUIPMENT		
1	Safety Cabinet	9	9
1	Vent Area	30	30
1	Sink Area	10	10
		Subtotal	***49***
SUB TOTAL THIS PAGE			***299***
TOTAL SQUARE FEET			**1787**

HUNTERDON CENTRAL REGIONAL HIGH SCHOOL

TECHNOLOGY LABORATORY



BIOCHEMISTRY LABORATORY

BIOCHEMISTRY LABORATORY

STUDENT CAPACITY FOR INSTRUCTIONAL PURPOSES OF
24 MAXIMUM
1727 SQUARE FEET

PROGRAM NARRATIVE AND SPECIAL FEATURES

The biochemistry program combines the study of biology and chemistry in an interdisciplinary way to allow students to understand the complex relationships between the two disciplines. Instruction will focus on both classroom rhetoric and hands on as well as simulated laboratory experiences. Students may be working in either the classroom environment or the laboratory environment and there may be times when parts of the class are working in both environments.

COMPUTER CONTROL AREA AND COMPUTER STATIONS

The biochemistry laboratory anticipates intensive use of computers as part of the science teaching/learning environment.

A total of twelve computer stations are desired. Eight of those stations should be IBM or IBM compatible machines and four stations should contain Macintosh or Macintosh compatible machines.

The computer stations should be linked to the computer control area and the teacher should be able to monitor and interact with each student computer station as well as transfer files between student and teacher stations. All computer stations should be interconnected with the school's library/media center/communications center as well as to external databases.

The particular computers to be chosen is a decision better put off until closer to the point of actually equipping the lab. An IBM 386 machine might be adequate but a better choice for the long term given the current state of technology would be the IBM 486s with 16 mg of internal RAM and a hard disk with a minimum of 120 mg of external memory as a server to the stations. Indications are, however, that the programs that are as sophisticated as those used in science and with the associated mathematics will be memory hogs both internally and externally and the bigger the server memory and hard disk space the better. Optical Read-Write Discs with 1.2 Gigabites of memory may ultimately be a more cost efficient choice. In the Macintosh realm, a Macintosh FX machine with 16 mg of internal memory should be connected to the same server as the IBM machines.

All computers should be equipped with a video logic board, and ADC Interface, a math co-processor, and a modem. As peripheral equipment each computer station should have a video disk player and a CD ROM Disk Drive.

As an initial selection the CUPLE Toolbox would appear to be a good choice of software programs. It is expected in its latest release to contain at least the following software: Microsoft Word and Excel, Notebook, a database, Turbo Pascal, Calculator, Equations and Mathematica. Hypercard should be available for the Macintosh computer to provide a front end for interactive video programs. A similar program in the IBM realm should also be available for expansion in interactive video to the IBM Stations.

THE SCIENCE PROGRAM

Currently using PASCO materials in the Physics program and we will be using the IBM Personal Science Library in the Honors Science program.

All 12 of the computers should be networked and driven by a server computer that is located in the computer control area. This server should also drive a video projector that is mounted on the ceiling or a video display panel that could be a large screen. This server should also be the connecting link for both audio and video telecommunication.

Printers should be available at each of the server computer stations. There could be a mix of laser, ink jet and dot matrix printers. There should be at least one color printer. They should be capable of reproducing graphics.

Computer stations should be on the periphery and should be wired back to the laboratory station probes. Students should be able to turn from the laboratory stations to the computer area and sit down at a computer to devise and monitor experiments, engage in interactive video instruction or use the computer as a tool in calculating equations or performing other scientific operations. There should be overhead storage above the computer stations for storage of computer software and manuals. The periphery should also contain storage for scientific and laboratory apparatus. There should be little or no storage on the islands

Storage should be available for the following:
glassware
probes for ADC device
hardware (ring stands, Bunsen burners, rings, clamps)
specimens
displays
chemicals
computer software
laser disks
portable electronic equipment
electronic balances-these could be secured on the
perimeter tops
one analytical electronic balance
gas cylinders
distilled water
small equipment such as rubber stoppers, tongs, scoopula, etc.
hot plates
Receptacles for disposal should be available. The following disposal will be necessary:

- dry chemicals
- environmental hazards
- organic chemicals
- paper

SAFETY CONSIDERATIONS

The following safety components should be available:

- master shutoff for gas and electric
- ground fault interrupters
- goggles cabinet
- fire blanket
- fire extinguishers
- eye wash stations
- safety shower
- exhaust hoods

LECTURE DEMONSTRATION AREA

The Science curriculum would emphasize project and group work. Problem solving will also be encouraged. Therefore, there will be an emphasis on cooperative learning and group activities, the small desks should be able to be pushed together to create larger working areas.

In the demonstration and lecture area, there should be 24 student stations larger than 2 feet by 3 feet. Electrical outlets should be available so that the desks will either have access or can easily be moved to electrical outlets. Floor recessed outlets in a grid pattern would be ideal.

There will not be a need for a demonstration desk since wither one of the island stations or the fume hood should be close enough to the lecture/demonstration area that it could be used for that purpose.

In the lecture area, there should only be a lectern available and a computer control area that controls not only other computer stations but peripherals for multimedia presentations.

LABORATORY AREA

The Laboratory area should be equipped with 12 computer stations, 8 science laboratory stations, three hood stations: chemical, biological and environmental, perimeter storage, microscope storage and a display case. Laboratory stations should be of the island variety and should have at least two sinks available for preparing and cleaning up both chemical and biological activities. At each of the 8 stations there should also be gas and water available. The sinks should be contained at one end of the island. Electric and ADC (probe) capabilities should be located at the other end. Each laboratory station should also incorporate a hot plate for heating of various biological and chemical media. All sinks should have acid traps

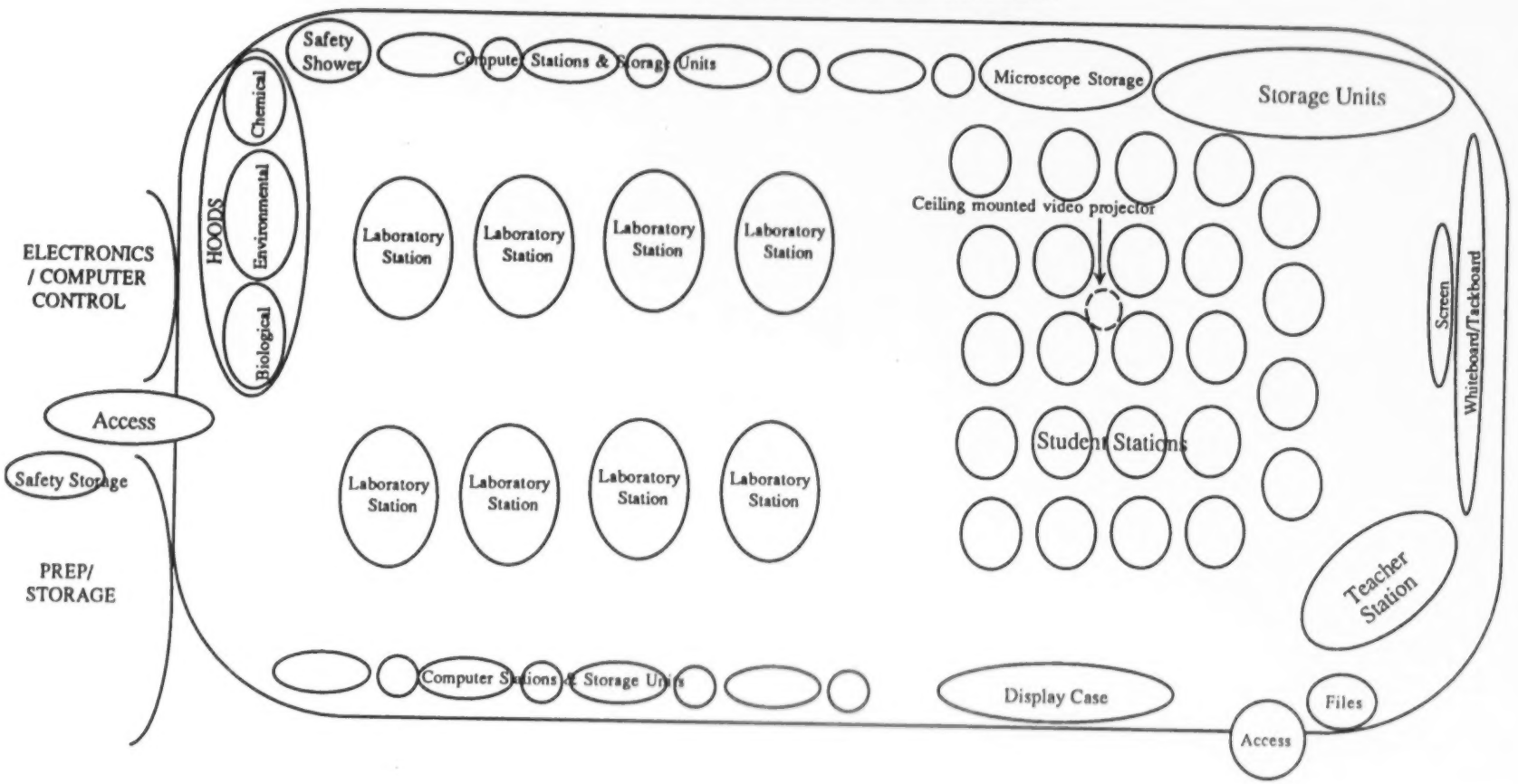
BIOCHEMISTRY LABORATORY

LISTING OF
OCCUPANTS, EQUIPMENT AND FURNISHINGS

Number	Item	Net Square Feet	Total Square Feet
	OCCUPANTS		
24	Students	20	480
1	Teacher	20	20
		Subtotal	***500***
	CLASSROOM AREA		
24	Student Stations	6	144
24	Student Chairs	1.5	36
1	Teacher Station w/ chair	20	20
	Ceiling Mounted Video Projector	No Floor	Space
		Subtotal	***200***
	LABORATORY AREA		
8	Lab Stations	50	400
8	Computer Stations (IBM)	10	80
4	Computer Stations (MAC)	10	40
8	Lab Storage Units	10	80
		Subtotal	***600***
	HOODS		
1	Chemical Hood	20	20
1	Environmental Hood	20	20
1	Biological Hood	20	20
		Subtotal	***60***
	OTHER		
1	Display Case	25	25
1	Safety Shower	6	6
1	Microscope Storage	10	10
	Storage Cabinets / Counterspace/Sinks	360	326
		Subtotal	***367***
TOTAL SQUARE FEET			**1727**

HUNTERDON CENTRAL REGIONAL HIGH SCHOOL

BIOCHEMISTRY LABORATORY



SCIENCE - TECHNOLOGY
PREPARATION/STORAGE AREA

SCIENCE - TECHNOLOGY
PREPARATION/STORAGE AREA

NO STUDENT CAPACITY

400 SQUARE FEET

PROGRAM DESCRIPTION

Provides an area for teacher preparation of laboratory activities and storage of instructional materials.as well as materials requiring secure or safety storage.

Number	Item	Net Square Feet	Total Square Feet
	Teachers (3)	90	90
3	Teacher Station/Chairs	12	36
1	Safety Refrigerator/Freezer	8	8
2	Drying Ovens	No floor space	
2	Incubators	No floor space	
1	Distilled water unit	2	2
1	Sterilizing water unit	5	5
1	Hood	9	9
3	File cabinets	6	18
3	Bookcase units	6	18
	Counter/cabinets/sink	214	214
TOTAL SQUARE FEET			**400**

SCIENCE - TECHNOLOGY PREP/STORAGE AREA